<u>AMENDMENTS TO THE CLAIMS</u>

This listing of claims will replace all prior versions of claims in the application:

Listing of Claims:

1. (Currently Amended) A computer-readable medium having computer-readable instructions embedded therein which, when executed by a computer, cause the computer to implement a method for facilitating determination of equilibrium values, comprising:

receiving supply and demand data for a <u>market</u> system;

demarcating at least a subset of the data into <u>buyer</u> ~~demander~~ data and <u>seller</u> ~~supplier~~ data

applying a polynomial-time approximation method to the demarcated data to generate an approximate equilibrium <u>price vector for the market system</u> ~~value for the system~~, the polynomial-time approximation method comprises:

initializing with an arbitrary first price vector;

setting a variable, D, to represent a maximum deficiency of the price vector;

constructing an instance, M_p, of a dichotomous market, ~~wherein constructing the instance,~~ $\cancel{M_p}$~~, of the dichotomous market comprises:~~

~~providing~~ $\cancel{m}$ ~~types of goods and~~ $\cancel{n+1}$ ~~buyers;~~

~~setting, for~~ $\cancel{i=1,\ldots,n}$~~, a utility of buyer~~ $\cancel{i}$ ~~for the goods as a utility of a corresponding agent in an original instance; and~~

~~establishing the budget of buyer~~ $\cancel{i}$ ~~according to:~~

$$\cancel{e_i := \sum_{j=1}^{m} p_j w_j^i,}$$

~~where buyer~~ $\cancel{(n+1)}$ ~~has a budget of~~ $\cancel{e_{n+1} := D}$ ~~and a utility for good~~ $\cancel{j}$ ~~is equal to a price of good~~ $\cancel{j}$~~,~~ $\cancel{p_j}$~~., wherein~~ $\cancel{e_i}$ ~~is the budget,~~ $\cancel{m}$ ~~is equal to the types of goods and~~ $\cancel{w_j^i}$ ~~is equal to an initial amount of good~~ $\cancel{j}$ ~~that buyer~~ $\cancel{i}$ ~~possesses;~~

executing a DPSV algorithm on the instance, M_p, starting from the price vector p and increasing prices until equilibrium is reached, and outputting a second price vector (p') via execution of the algorithm;

setting a budget for i for every agent i with respect to the second price vector according to:

$$e_i' := \sum_{j=1}^{m} p_j' w_j^i ;$$

determining if a budget ratio for every agent i satisfies a budget ratio constraint of:

$$e_i'/e_i \leq 1+\varepsilon ,$$

where ε represents a desired amount of approximation;

outputting the second price vector when the budget constraint is satisfied, as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector set equal to the second price vector when the budget constraint is unsatisfied;

sending results from the polynomial-time approximation method to an iterative analysis controller component to determine if the results meet a predetermined threshold error value to halt an equilibrium modeling component; and

outputting approximate equilibrium <u>price vector</u> ~~value~~ data to a computer monitor display.

2. (Canceled)

3. (Currently Amended) The computer-readable medium of claim <u>1</u> ~~2~~, the approximate equilibrium price vector, comprising an approximate equilibrium price vector, $\mathbf{p}^*$, that produces, in conjunction with a bundle of goods, x^i, for each agent i, an ε-approximate equilibrium for the market system such that:

for every good j:

$$(1-\varepsilon)\sum_{i=1}^{n} w_j^i \leq \sum_{i=1}^{n} x_j^i \leq \sum_{i=1}^{n} w_j^i;$$

for all i, a utility, $\sum_{j=1}^{m} u_{ij} x_j^i$, of agent i is at least $(1-\varepsilon)$ times a value of an optimum solution of a maximization of utility function, $u_i(x)$, subject to:

$$\sum_{j=1}^{m} p_j^* x_j \leq \sum_{j=1}^{m} p_j^* w_j^i; \qquad \text{(Eq. 1)}$$

where m represents types of divisible goods being traded in the market system and w_j^i indicates an initial amount of good j that agent i possesses.

4. (Currently Amended) The computer-readable medium of claim 1 ~~2~~, the polynomial-time approximation method comprising an iterative method that utilizes, at least in part, revenue generated in a previous iteration for a specific agent as a budget for the specific agent in a current iteration.

5. (Previously Presented) The computer-readable medium of claim 4, the iterative method further utilizing a dummy buyer to account for residual goods.

6. (Previously Presented) The computer-readable medium of claim 1, the polynomial-time approximation method comprising, at least in part, a linear utility function relating to at least one agent.

7. (Canceled)

8. (Canceled)

9. (Canceled).

10. (Canceled)

11. (Currently Amended) The computer-readable medium of claim 1 ~~2~~, the polynomial-time approximation method yielding an exact equilibrium price for the market system.

12. (Currently Amended) A computer-implemented method for facilitating determination of equilibrium values, comprising:

receiving supply and demand data for a market system via a computer processor;

demarcating at least a subset of the data into buyer ~~demander~~ data and seller ~~supplier~~ data;

applying a polynomial-time approximation method to the demarcated data to generate an approximate equilibrium price vector for the market system ~~value for the system~~, the polynomial-time approximation method comprises:

initializing with an arbitrary first price vector;

setting a variable, D, to represent a maximum deficiency of the price vector;

constructing an instance, M_p, of a dichotomous market, ~~wherein constructing the instance,~~ $\cancel{M_p}$~~, of the dichotomous market comprises:~~

~~providing~~ $\cancel{m}$ ~~types of goods and~~ $\cancel{n+1}$ ~~buyers;~~

~~setting, for~~ $\cancel{i=1,\ldots,n}$~~, a utility of buyer~~ $\cancel{i}$ ~~for the goods as a utility of a corresponding agent in an original instance; and~~

~~establishing the budget of buyer~~ $\cancel{i}$ ~~according to:~~

$$\cancel{e_i := \sum_{j=1}^{m} p_j w_j^i,}$$

~~where buyer~~ $\cancel{(n+1)}$ ~~has a budget of~~ $\cancel{e_{n+1} := D}$ ~~and a utility for good~~ $\cancel{j}$ ~~is equal to a price of good~~ $\cancel{j, p_j}$~~.; wherein~~ $\cancel{e_i}$ ~~is the budget,~~ $\cancel{m}$ ~~is equal to the types of goods and~~ $\cancel{w_j^i}$ ~~is equal to an initial amount of good~~ $\cancel{j}$ ~~that buyer~~ $\cancel{i}$ ~~possesses;~~

executing a DPSV algorithm on the instance, M_p, starting from the price vector p and increasing prices until equilibrium is reached, and outputting a second price vector (p');

setting a budget for i for every agent i with respect to the second price vector according to:

$$e'_i := \sum_{j=1}^{m} p'_j w^i_j ;$$

determining if a budget ratio for every agent i satisfies a budget ratio constraint of:

$$e'_i / e_i \leq 1 + \varepsilon ,$$

where ε represents a desired amount of approximation;

outputting the second price vector when the budget constraint is satisfied, as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector set equal to the second price vector when the budget constraint is unsatisfied;

sending results from the polynomial-time approximation method to an iterative analysis controller component to determine if the results meet a predetermined threshold error value to halt an equilibrium modeling component; and

outputting approximate equilibrium <u>price vector</u> ~~value~~ data to a computer monitor display.

13. (Canceled)

14. (Currently Amended) The method of claim <u>12</u> ~~13~~, the approximate equilibrium price vector, comprising an approximate equilibrium price vector, $\mathbf{p}^*$, that produces, in conjunction with a bundle of goods, x^i, for each agent i, an ε-approximate equilibrium for the market system such that:

for every good j:

$$(1-\varepsilon)\sum_{i=1}^{n} w^i_j \leq \sum_{i=1}^{n} x^i_j \leq \sum_{i=1}^{n} w^i_j ;$$

for all i, a utility, $\sum_{j=1}^{m} u_{ij} x_j^i$, of agent i is at least $(1-\varepsilon)$ times a value of an optimum solution of a maximization of utility function, $u_i(x)$, subject to:

$$\sum_{j=1}^{m} p_j^* x_j \leq \sum_{j=1}^{m} p_j^* w_j^i; \qquad \text{(Eq. 1)}$$

where m represents types of divisible goods being traded in the market system and w_j^i indicates an initial amount of good j that agent i possesses.

15. (Currently Amended) The method of claim <u>12</u> ~~13~~, the polynomial-time approximation method comprising an iterative method that utilizes, at least in part, revenue generated in a previous iteration for a specific agent as a budget for the specific agent in a current iteration.

16. (Previously Presented) The method of claim 15, the iterative method further utilizing a dummy buyer to account for residual goods.

17. (Canceled)

18. (Canceled)

19. (Canceled)

20. (Currently Amended) The method of claim <u>12</u> ~~13~~, the polynomial-time approximation method yielding an exact equilibrium price for the market system.

21. (Canceled)

22. (Canceled)

23. (Currently Amended) A system that facilitates determination of equilibrium values, comprising:

means for receiving supply and demand data for a market system, and demarcating at least a subset of the data into buyer ~~demander~~ data and seller ~~supplier~~ data;

means for applying a polynomial-time approximation method to the demarcated data to generate an approximated equilibrium price vector for the market system ~~value for the system~~,

the polynomial-time approximation method comprises:

initializing with an arbitrary first price vector;

setting a variable, D, to represent a maximum deficiency of the price vector;

constructing an instance, M_p, of a dichotomous market, ~~wherein constructing the instance, M_p, of the dichotomous market comprises:~~

~~providing m types of goods and $n+1$ buyers;~~

~~setting, for $i=1,\ldots,n$, a utility of buyer i for the goods as a utility of a corresponding agent in an original instance; and~~

~~establishing the budget of buyer i according to:~~

$$\cancel{e_i := \sum_{j=1}^{m} p_j w_j^i;}$$

~~where buyer $(n+1)$ has a budget of $e_{n+1} := D$ and a utility for good j is equal to a price of good j, p_j.; wherein e_i is the budget, m is equal to the types of goods and w_j^i is equal to an initial amount of good j that buyer i possesses;~~

executing a DPSV algorithm on the instance, M_p, starting from the price vector p and increasing prices until equilibrium is reached, and outputting a second price vector (p');

setting a budget for i for every agent i with respect to the second price vector according to:

$$e_i' := \sum_{j=1}^{m} p_j' w_j^i;$$

determining if a budget ratio for every agent i satisfies a budget ratio constraint of:

$$e_i'/e_i \leq 1+\varepsilon\,,$$

where ε represents a desired amount of approximation;

outputting the second price vector when the budget constraint is satisfied, as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector set equal to the second price vector when the budget constraint is unsatisfied;

means for sending results from the polynomial-time approximation method to an iterative analysis controller component to determine if the results meet a predetermined threshold error value to halt an equilibrium modeling component; and

means for outputting approximate equilibrium price vector ~~value~~ data to a computer monitor display.

24. (Canceled)

25. (Currently Amended) The system of claim 23 ~~24~~, the polynomial-time approximation method comprising an iterative method that utilizes, at least in part, revenue generated in a previous iteration for a specific agent as a budget for the specific agent in a current iteration.

26. (Currently Amended) The system of claim 23 ~~24~~, the polynomial-time approximation method employing, at least in part, a dichotomous market solution algorithm to provide at least one price selected from the group consisting of an approximate market equilibrium price and an exact equilibrium market price.

27. (Canceled)

28. (Canceled)

29. (Canceled)

30. (Canceled)